5th Generation Comms: What's being done to ensure the F-22 and F-35 can talk to each other ... and the rest of the Air Force?

By Brian W. Everstine, Pentagon Editor

The F-22 Raptor, the Air Force's fifth generation air superiority fighter, has been described as a "game-changer" in current Middle East operations, using its advanced sensors to see huge swaths of territory and steer coalition aircraft around threats. As a de facto "quarterback" in the contested zone, it makes all other aircraft in the fight more effective.

That communication, though, is largely limited to radio calls. The F-22 can't transmit the most sensitive data it collects to any aircraft besides other F-22s. While it can receive Link 16 data from other aircraft, it can't pass along its "God's-eye view" to other players in the force. Even the other fifth generation fighter, the F-35, can't communicate with the F-22 except at the voice level.

An F-35, an F-15C, and an F-22 on the ramp at Gwangju AB, South Korea, during exercise Vigilant Ace-18. Including both fourth and fifth generation aircraft in exercises enhances interoperability. (Photo Courtesy of U.S. Air Force)

The situation wasn't brought about by negligence. In developing the F-22—and later, the F-35—designers needed to preserve the jets' stealth against rapidly evolving adversaries. Standard radio emissions would reveal their locations, which meant devising ways the low-observable fighters could talk to each other without giving away their position. Both jets have what are called "low probability of detection/intercept" communications gear to stay hidden. The F-35's system—because it was developed 10 years after the F-22's—takes a different approach.

As a result, Air Force combat communications can become a kind of Tower of Babel. While Raptors can receive over the Link 16 network—the standard across U.S. and NATO aircraft—it can't transmit over the system. Instead, it uses the F-22-only Intra-Flight Data Link (IFDL). F-35s can transmit on Link 16 to fourth gen jets and talk among themselves using the stealthy Multifunction Advanced Data Link (MADL), a capability the Air Force had planned to install on the F-22 but canceled because of cost about five years ago.

The Air Force's goal is to harmonize all these systems so that everyone can talk among themselves—both by voice and machine-to-machine—without an enemy listening in or figuring out where those stealth jets are.

Fixing the situation is "part of the larger effort to figure out how we're going to move away from having a bunch of Rube Goldberg gateways trying to connect things, to having a jump to the next generation of networks and radios and how they talk to each other," Air Combat Command head Gen. James M. Holmes told Air Force Magazine in November.

The Air Force is looking at this problem with "two lines of effort" for the near-term and long-term.

For the near-term, the Air Force has multiple "small-scale experimentation campaigns" aimed at reducing risk and quickly fielding advanced data links, along with enhancing the current datalinks, reported Lt. Gen. Jerry D. Harris Jr., the deputy chief of staff for strategic plans and requirements, in written answers to questions from the House Armed Services Tactical Air and Land Forces Subcommittee in June.

"These experiments are demonstrating correlation/fusion of data from multiple sources, including intelligence sources and fifth generation fighters," Harris wrote.

The first stage of this effort focuses on the F-22 being able to transmit on Link 16. The service has a funded program on the books to address this, called TACLink 16. The program, which had $41.7 million budgeted for Fiscal 2017, is scheduled to begin fielding in Fiscal 2021, Harris said. Service officials have said they hope to go even faster.

Two F-15s take off at JB Elmendorf-Richardson, Alaska. One carries a Talon HATE pod—a communications translator device. (Photo Courtesy of U.S. Air Force)

Link 16 transmit is crucial. If the fighter isn't transmitting over this network, other aircraft in the fight can't "employ weapons on enemy forces without first identifying F-22 position by means of multiple radio calls," Air National Guard Director Lt. Gen. L. Scott Rice said in his modernization priorities outline for 2017. The Guard flies 11 percent of the F-22 fleet and has deployed multiple times for combat. This issue is "compounded" because fourth generation fighters can't track Raptors with their own sensors.

The ability for the F-22 to transmit its "most advanced sensor," Rice wrote, will permit it to "share high-fidelity data of air and surface tracks," which in turn will significantly increase "the combat capability of every asset that is Link-16 capable."

While USAF presses on with TACLink 16, it's looking for industry to supply a quick means to bridge fourth and fifth generation aircraft. In October, the service released a request for information to industry calling for systems that could be a "gateway" between fourth and fifth generation aircraft. The request came with the proviso, however, that the system could be ready within 12 months.

This document was "market research" by the Air Force, looking at what industry has ready to address this problem, according to the Air Force Life Cycle Management Center.

The Link 16 system, which dates back to the development of the Joint Tactical Information Distribution System starting in the mid-1970s, broadcasts on a frequency that can easily be picked up by enemy signals intelligence. New systems transmit data in a more stealthy manner.

Boeing's secretive Phantom Works division is testing a program allowing the F-22 to communicate securely with its fourth generation air superiority counterpart, the F-15C Eagle.

The U.S. Air Force Tactical Exploitation of National Capabilities (TENCAP) office in Air Combat Command worked alongside Boeing's Phantom Works to develop Talon HATE: a communications translator pod carried on the F-15C. The 17-foot, 1,844-pound pod includes an adaptive sensor, multidomain information processor, and a network communications gateway that allows the Eagle to communicate with the F-22 securely over a common data link, according to Boeing.

In September 2017, Boeing delivered four of these systems and finished modifications to F-15Cs, Boeing Phantom Works spokeswoman Cheryl Sampson told Air Force Magazine.

"They offer a giant leap forward in tactical fighter capability with real-time connectivity and expanded information sharing," Sampson said. "Boeing demonstrated secure data link connections between F-15Cs and F-22s in a way that integrates information for the pilot in a common operating picture."

Northrop Grumman has pitched a different way to help F-22s and F-35s securely talk in flight, by adding another aircraft—Northrop suggests its own RQ-4 Global Hawk—to fly in the area with its "Freedom 550" radio. This "production-ready … software-defined" radio is built using avionics Northrop developed for both the F-35 and F-22. That means the system can translate among IFDL, MADL, and Link 16.

Northrop tested the radio through more than 400 flight hours in 2014 as part of an Air Force-sponsored experiment called the Jetpack Joint Capability Technology Demonstration.

In February 2017, the company conducted a trial with the United Kingdom Royal Air Force, integrating the radio with the F-35B and Typhoon FGR4 aircraft. During the UK Ministry of Defense-funded trial, called Babel Fish III, Northrop's system translated F-35B messages to Link 16, which was received by the Typhoon.

The demonstration was the first time non-U.S. fifth and fourth generation aircraft have shared stealthy data, according to Northrop. "Being able to network sensor data between fifth generation and fourth generation fast-jets and other battlespace assets in a stealthy matter is critically important to enabling the full capability offered by fifth generation aircraft," said Andrew Tyler, the chief executive of Northrop Grumman Europe, in a statement announcing the demonstration.

Lockheed Martin has offered an effort to let F-22s communicate with fourth generation aircraft, through its Project Missouri program. Using a Rockwell Collins radio for Link 16 and L-3 Communications devices for encrypted communications, the Raptors were able to transmit to ground stations and an F-35 avionics test bed in late 2013. The capability has flown in exercises since the initial demonstration, as recently as the Northern Edge exercise in May 2017.

The F-22's inability to share data has been an issue afflicting USAF operations since the fleet became operational. Some have speculated that the lack of stealth data sharing kept the Raptor from participating in the 2011 air campaign in Libya.

The Air Force acknowledges the communications restrictions, and both F-22 and F-35 pilot training includes workarounds to allow the stealth jets to communicate with their nonstealthy stablemates.

In July 2017, all types of USAF stealth aircraft—F-22s, F-35As, and B-2 bombers—participated in a Red Flag exercise at Nellis AFB, Nev. Marine Corps F-35Bs participated, as well. Pilots needed to talk with each other over "secure voice" systems as the jets flew "strategic attack scenarios" against an integrated air defense system, said Capt. Neil M. Fournie, the advanced warfighting chief of the 414th Combat Training Squadron.

Because the F-35 does have the ability to share over Link 16, it was a more capable "quarterback" in that fight, when the battle was taking place in a "permissive" environment.
During Red Flag 17-1, five months earlier, F-35As from Hill AFB, Utah, flew with British Typhoons to take out a "high-value target" in a training exercise. The F-35 pilots used Link 16 data to communicate with the Typhoons, while also using MADL to share a greater level of data, stealthily, with other F-35s.

"The thing that's great about having Link 16 and MADL onboard and the sensor fusion is the amount of situational awareness the pilot has," said Lt. Col. George Watkins, commander of the 34th Fighter Squadron at Hill, in a release about the mission. "I'm able to directly communicate with specific formations, and I can see the whole war and where all

the players are from a God's-eye view. That makes me more effective because I know who to talk with and at what times, over the secure voice."

While the legacy Link 16 system lets F-35 pilots speak with older aircraft, the advanced system is the preferred method.

"It's the data link that we use to communicate just between F-35s," he said. "It's a solid architecture and from my experience it's been very stable. The pilots rely on it for fighting, and at night we fly what we call sensor formations and we use MADL to keep our situational awareness."

Speaking last March, shortly after that Red Flag exercise, USAF Chief of Staff Gen. David L. Goldfein detailed this capability as he highlighted the need for next generation, multidomain command and control. F-35s, he said, were not only fusing information from other aircraft, but also from cyber and space assets that were participating in the exercise. The exercise included a combat search and rescue scenario, all while facing the threats of air defenses.

The F-35's situation, as displayed on the pilot's visor, was also "replicated in other command-and-control agencies," which allowed the F-35 pilot to "perform as the quarterback of the joint team, as they went in to accomplish all of these simultaneous missions," Goldfein said. "So when I talk to you about situational awareness, this was an example at the tactical level to produce operational effects."

Outside of Red Flag, F-22s have participated in several high-profile exercises that sought to knit USAF and international crews together when performing air superiority and other missions.

JB Langley-Eustis, Va., as one of the service's major Raptor bases, has hosted premiere fighters of close allied air forces in training missions meant to ensure they can cooperate on "Night One" of a major operation. The first of two Atlantic Trident exercises in 2015 brought together United Kingdom Eurofighter Typhoons, French Dassault Rafales, and USAF F-22s in an attempt to "get back into high-end training," Royal Air Force Chief of Staff Air Chief Marshal Sir Andrew Pulford said at the outset of the exercise. The war game focused on logistics and getting the aircrews acquainted in operating together, including addressing issues of communication in the air.

In April 2017, the three types of advanced jets came back together at Langley for the second iteration of the exercise and to build on the initial progress. For the second round, the Air Force also sent F-35As. The pilots needed to refine their communication and tactics, so they would be ready for "Night One interoperability," then-1st Fighter Wing Commander Col. Peter M. Fesler told Air Force Magazine. The aircraft flew 510 sorties together over three weeks.

"All these aircraft have tremendous capabilities, but if we don't plan them and integrate them and understand each other's capabilities and limitations—and use them to their full potential—then we could lose in any combat scenario," said Lt. Col. Brad Bashore, commander of the 58th Fighter Squadron.

The possibilities for improved secure communication and data sharing will touch the Air Force's mobility community, as well.

Air Mobility Command chief Gen. Carlton D. Everhart II floated an idea at AFA's Air, Space & Cyber Conference last September that USAF's 11,000-plus mobility aircraft, including KC-135s, KC-10s, and soon KC-46s, could link F-22s and F-35s during combat operations.
"Why not use them as relay platforms?" Everhart asked.

Tankers could automatically offload data collected by F-35 and F-22 sensors, freeing up the fighters' onboard cache, while also getting intelligence and surveillance data to analysts in a timely manner.

All of these programs, tests, and evaluations are aimed at near-term solutions, addressing as well problems being faced in ongoing combat operations, but, as Holmes said, they amount to a "bunch of Rube Goldberg gateways." For the longer-term, the Air Force wants holistic communication and data sharing.

The Air Force's Air Superiority 2030 Flight Plan, completed in the spring of 2016, outlined current and future threats to readiness. As directed under the plan, USAF is conducting an Advanced Battle Management System analysis of alternatives due to be completed in 2018. It will include the next generation of networks and radios. In addition, the plan calls for a development effort focused on agile communications, including adaptable networks for operations in "highly contested" environments.

"The agile communication capabilities-based assessment is defining communication gaps that the Air Force must mitigate in (anti-access/area-denial) environments in the 2030-plus time frame," Harris told lawmakers. "The outcome of

each of these efforts will inform the path forward for communications capabilities that enable interoperability across the A2/AD environment."

The focus ultimately can't be on communications between specific planes or on an endless litany of demonstrations, Holmes said. "The issue to me is not when we're going to make the F-22 and F-35 talk to each other, it's when we'll have everything talk to each other," he said.
It is a priority, "but I've got all kinds of priorities."

Goldfein feels strongly enough about "multidomain command and control" that he's made it one of his three main focus areas during his tenure as Chief, and he's directed a one-star general to research it.

"This evolution in our command-and-control capabilities requires new thinking, new training, and perhaps new technologies or ways to use older technology," Goldfein said in a March 2017 letter to airmen. "We will need to integrate real-time information from a variety of sources—some nontraditional—and evaluate that information as fast as systems can process it. If an enemy blocks actions in one domain, we quickly 'call an audible' to change the play and attack or defend from another. Future multidomain operations will be high velocity, agile, and joint by their very nature."

Goldfein tapped the Air Force's director of current operations, Brig. Gen. Chance Saltzman, for the study, with a charter to look at common mission systems, common data, and common architecture. Machine-to-machine teaming is seen as the major part of the solution to help the Air Force process massive volumes of intelligence, surveillance, and reconnaissance, from cyber and space assets, which can be disseminated to an airborne fleet.

"We're operating in all these domains," Goldfein said in announcing this effort in September 2016. "Gaining information and clarity on issues that are sensing in ways we have not sensed before. We're achieving decisions at a speed that we've not seen before. So we're going to have to ensure that we're ready for the speed of conflict."